

MISSISSIPPI HURRICANE EVACUATION STUDY

BEHAVIORAL ANALYSIS

(Taken from Chapter 4 of the Technical Data Report)

INTRODUCTION

The behavioral analysis is conducted to provide estimates of public response to a variety of hurricane threats. These estimates are used in the shelter analysis and transportation analysis, and as guidance in emergency decision-making and public awareness efforts.



OBJECTIVES

The specific objective of the behavioral analysis is to answer the following questions:

1. What percentage of the population will evacuate under a range of hurricane threat situations or in response to evacuation advisories?
2. When will the evacuating population leave in response to an evacuation order given by local officials?
3. How many vehicles will the evacuating population use during a hurricane evacuation?
4. How many evacuating vehicles will be towing boats, camper trailers, or other vehicular equipment?
5. What are the destinations of the evacuees and what type shelter will they be heading for?
6. How will the threatened population respond based upon forecasts of hurricane intensity or other information provided during a hurricane emergency.

METHODOLOGY

Every evacuation plan must contain estimates and assumptions about how people will react when a hurricane evacuation is implemented. Behavioral assumptions for the Mississippi coastal counties were developed by statistical analysis of data, which was gathered from, telephone interviews and actual response data from previous hurricane evacuations.

Actual behavior in a single event can be documented and compared to estimated behavioral characteristics for a specific location. It is tempting to over generalize from a single evacuation, however, we know that people will respond differently in different sets of circumstances and at different points in time. We are fortunate to have amassed actual response data from many hurricane evacuations spanning a wide geographical area and a variety of hurricane threat circumstances over a period of roughly three decades.



Part of this analysis includes telephone interviews in which residents of the region were asked how they responded during Hurricane Georges in 1998. Data from an earlier survey regarding response in Hurricane Georges is also employed in the study. Older data concerning responses in Hurricanes Camille and Frederic were also available. Another major component of this current behavioral analysis involved a sample survey documenting residents' beliefs about their exposure to hurricanes, their intentions to respond in future hurricane threats, and demographic information which could be related to their behavior.

MISSISSIPPI SAMPLE SURVEYS

In 1999 a survey was conducted in several Gulf Coast locations documenting response in Hurricane Georges. As part of that study 200 telephone interviews were conducted in Mississippi. All of the respondents lived in areas of coastal counties advised by officials to evacuate in Hurricane Georges.

In the summer of 2000 an additional telephone survey was performed in Mississippi. A total of 300 interviews were completed in the three coastal counties, with the respondents equally divided among three risk areas. The three risk areas are shown in the Table 4-1 below.

TABLE 4-1 HURRICANE RISK AREAS

High Risk Area	Medium Risk Area	Low Risk Area
Category 1-2 Surge Area	Category 3-5 Surge Area	Upland Non-surge Area
Evacuation Zone A	Evacuation Zone A,B&C	Mobile Home Evacuation

The new survey gives a better indication of how responses, perceptions, and response intentions vary among the evacuation zones. The earlier post-Georges survey responses came from an area roughly the same as the category 1-2 area in the newer survey, but smaller in some communities. Interviews were divided among the Mississippi coastal counties proportional to population in each of the risk zones.

Two hundred interviews were also conducted in the Jefferson and Orleans Parishes in Louisiana. It is anticipated that a significant number of evacuees from those parishes will travel into and through Mississippi, and the interviews were performed to estimate that number.

ANALYSIS OF SURVEYS

Behavioral studies are statistical. In general, the larger the number of people in the sample, the closer the sample value will be to the true value. A sample of 100 will provide estimates which one can be 90 percent "confident" that they are within 5 to 8 percentage points of the true values. With a sample of 50, one can be 90 percent "confident" of being within 7 to 11 percentage points of the actual population value.

RESPONSE RATES IN HURRICANE GEORGES

The post-Hurricane Georges survey indicated that almost half the respondents left their homes in the category 1-2 evacuation zones in Hurricane Georges, and about 40 percent left in other parts of the coastal counties (Table 4-2). The 1999 survey found that 60 percent of the Mississippi respondents evacuated in Hurricane Georges, but the 1999 interviews were restricted to the areas explicitly directed by officials to evacuate in that storm.

**TABLE 4-2
PERCENT OF RESPONDENTS
EVACUATING IN HURRICANE GEORGES, BY RISK ZONE**

	Cat 1-2 Zone (N=99)	Cat 3-5 Zone (N=94)	Non-Surge Zone (N=106)
Evacuees	48	42	40

Almost half the category 1-2 zone respondents who stayed in their homes in Hurricane Georges said they would have evacuated if they had felt the threat posed by the storm had been greater (Table 4-3). More than a third of the stayers in the category 3-5 and non-surge areas gave that response. Eighty-five percent of those who didn't evacuate in Hurricanes Georges from the high-risk zone said they had made preparations to do so in case the threat worsened, as did more than 60 percent in the other two risk zones (Table 4-4).

TABLE 4-3
PERCENT OF STAYERS IN HURRICANE GEORGES SAYING
THEY WOULD HAVE LEFT IF THREAT WERE GREATER, BY RISK ZONE

	Cat 1-2 Zone (N=52)	Cat 3-5 Zone (N=55)	Non-Surge Zone (N=64)
Yes	48	36	39
No	44	53	53
Do not Know	8	11	8

TABLE 4-4
PERCENT OF STAYERS IN HURRICANE GEORGES SAYING THEY
HAD MADE PREPARATIONS TO LEAVE IF NECESSARY, BY RISK ZONE

	Cat 1-2 Zone (N=52)	Cat 3-5 Zone (N=55)	Non-Surge Zone (N=64)
Yes	85	62	69
No	14	35	28
Do not Know	2	4	3

When those who did not evacuate in Hurricane Georges were asked why they did not, the great majority indicated that Hurricane Georges was not severe enough or its track was not the sort to pose a threat to their safety (Table 4-5). No one said they failed to leave because they had no transportation, but four percent in the category 1-2 surge zone said they had no place to go.

**TABLE 4-5 REASONS GIVEN FOR NOT EVACUATING
(PERCENT OF STAYERS) BY RISK AREA**

	Cat 1-2 Zone (N=51)	Cat 3-5 Zone (N=54)	Non-Surge Zone (N=64)
House Safe	77	74	91
Officials Said OK	4	4	0
Media Said OK	6	6	0
Friends Said OK	8	6	6
Officials Didn't Say Go	14	6	2
Low Probabilities	26	6	14
Other Low Chance of Hit	12	6	0
No Place to Go	4	2	2
Protect Against Looters	10	2	0
Protect Property from Storm	8	7	3
Past False Alarm	14	4	8
Job	4	6	5
Waited Too Long	4	4	0
Traffic Bad	6	0	5
Tried, Returned	2	2	2
No Place for Pets	0	0	2
Other	8	4	3
Do not Know	2	4	2

In the category 1-2 evacuation zone 85 percent of those who did not evacuate in Georges said they had a concern about being trapped on evacuation routes as the storm arrived, and 75 percent from the category 3-5 evacuation zone gave that same response (Table 4-6). This is even higher than responses to that question in places like New Orleans and the Florida Keys. More than a third gave that response in non-surge areas of Mississippi. At least half of the respondents expressing those concerns said they would probably be willing to evacuate if officials could monitor the progress of the evacuation and ensure that they did not begin evacuating without adequate time to reach safety (Table 4-7).

TABLE 4-6
PERCENT OF STAYERS IN HURRICANE GEORGES
SAYING THEY WERE CONCERNED ABOUT BEING
CAUGHT ON THE ROAD DURING EVACUATION, BY RISK ZONE

	Cat 1-2 Zone (N=52)	Cat 3-5 Zone (N=55)	Non-Surge Zone (N=64)
Yes	85	75	36
No	14	22	63
Do not Know	2	4	2

TABLE 4-7
PERCENT OF STAYERS IN HURRICANE GEORGES CONCERNED
ABOUT BEING CAUGHT ON THE ROAD WHO WOULD PROBABLY
LEAVE IF GUARANTEED ADEQUATE TRAVEL TIME, BY RISK ZONE

	Cat 1-2 Zone (N=45)	Cat 3-5 Zone (N=43)	Non-Surge Zone (N=24)
Yes	56	51	67
No	38	33	25
Do not Know	7	16	8

When evacuees were asked what convinced them to go someplace safer, most expressed concerns about the strength of the storm and its effects, followed by appeals from friends and relatives (Table 4-8). Few said they left because officials called for their evacuation.

TABLE 4-8
REASONS GIVEN FOR EVACUATING
(PERCENT OF EVACUEES) BY RISK AREA

	Cat 1-2 Zone (N=52)	Cat 3-5 Zone (N=38)	Non-Surge Zone (N=41)
Officials Said Go	6	5	7
NWS Said Go	4	5	7
Police/Fire Said Go	11	5	2
Media Said Go	4	5	5
Friend/Relative Said Go	28	26	34
Storm Severe	47	45	46
Storm Increased in Strength	4	16	15
Concerned about Flooding	26	18	10
Concerned about Wind	28	29	20
Concerned about Road Flooding	6	0	5
Concerned Storm Would Hit	15	24	12
Heard Probability	6	3	12
Other	11	5	7

When asked specifically whether they heard, either directly or indirectly, that officials had called for them to evacuate, a majority (69 percent) said they did not, even in the category 1-2 risk area (Table 4-9). In the earlier Hurricane Georges survey slightly more said they heard evacuation notices (41 percent), and that survey was targeted specifically at areas told by officials to evacuate in Hurricane Georges. Only about 10 percent in the category 1-2 area and five percent in the other zones said they heard mandatory evacuation orders.

TABLE 4-9
PERCENT OF RESPONDENTS IN HURRICANE GEORGES HEARING
EVACUATION NOTICES FROM PUBLIC OFFICIALS, BY RISK ZONE

	Cat 1-2 Zone (N=99)	Cat 3-5 Zone (N=94)	Non-Surge Zone (N=106)
Heard Must	11	5	4
Heard Should	20	17	13
Heard Neither	69	78	83

In the surge zones hearing official evacuation notices increased the likelihood of evacuation substantially (Table 4-10). Over 90 percent of those in surge zones said they evacuated if they heard mandatory orders, although there were very few respondents who said they heard those orders. Taken collectively, averaging over both surge zones to increase sample size and statistical reliability, respondents who said they heard official evacuation notices of one kind or another were at least twice as likely to evacuate as those who said they heard no evacuation notices.

TABLE 4-10
PERCENT EVACUATING, BY EVACUATION NOTICE HEARD
BY RISK ZONE (SAMPLE SIZE VARIES BY CELL – SEE TABLE 4-9)

	Cat 1-2 Zone	Cat 3-5 Zone	Non-Surge Zone
Heard Must	91	100	50
Heard Should	65	64	80
Heard Neither	33	30	32

Most respondents, even in the category 1-2 risk area said their homes would not experience dangerous flooding from storm surge and waves in a 125-mph hurricane (Table 4-11). Barely half in any of the risk areas said their homes would be unsafe in a 125-mph hurricane, considering both wind and water (Table 4-12).

TABLE 4-11
PERCENT OF RESPONDENTS BELIEVING THEIR
HOMES WOULD FLOOD DANGEROUSLY FROM STORM
SURGE AND WAVES IN 125 MPH HURRICANE, BY RISK ZONE

	Cat 1-2 Zone (N=99)	Cat 3-5 Zone (N=94)	Non-Surge Zone (N=106)
Would Flood	34	35	24
Would Not Flood	59	55	73
Do not Know	7	10	4

TABLE 4-12
PERCENT OF RESPONDENTS BELIEVING THEIR
HOMES WOULD BE SAFE IN 125-MPH HURRICANE
CONSIDERING BOTH WIND AND WATER, BY RISK ZONE

	Cat 1-2 Zone (N=99)	Cat 3-5 Zone (N=94)	Non-Surge Zone (N=106)
Safe	39	39	46
Not Safe	51	52	50
Do not Know	10	9	5

Sixty-three percent of the residents of the category 1-2 surge area said their homes would flood dangerously in a category 5 hurricane like Hurricane Camille, but in the category 4-5 zone only half believed they would be at risk to flooding (Table 4-13). Twenty percent in the category 1-2 risk area and approximately 30 percent in the other risk areas said their homes would be unsafe in a category 5 storm like Hurricane Camille (Table 4-14).

TABLE 4-13
PERCENT OF RESPONDENTS BELIEVING THEIR HOMES
WOULD FLOOD DANGEROUSLY FROM STORM SURGE AND WAVES
IN CATEGORY 5 HURRICANE LIKE HURRICANE CAMILLE, BY RISK ZONE

	Cat 1-2 Zone (N=99)	Cat 3-5 Zone (N=94)	Non-Surge Zone (N=106)
Would Flood	63	50	46
Would Not Flood	30	47	48
Do not Know	7	3	6

TABLE 4-14
PERCENT OF RESPONDENTS BELIEVING THEIR HOMES
WOULD BE SAFE IN CATEGORY 5 HURRICANE LIKE HURRICANE
CAMILLE CONSIDERING BOTH WIND AND WATER, BY RISK ZONE

	Cat 1-2 Zone (N=99)	Cat 3-5 Zone (N=94)	Non-Surge Zone (N=106)
Safe	19	32	31
Not Safe	71	66	65
Do not Know	10	2	4

People who believe their homes would be unsafe in a 125-mph hurricane were much more likely than others to evacuate in Hurricane Georges (Table 4-15). The effect was present in all three risk zones.

TABLE 4-15
PERCENT EVACUATING, BY BELIEF HOME
WOULD BE SAFE IN 125 MPH HURRICANE, BY RISK
ZONE (SAMPLE SIZES VARY BY CELL - SEE TABLE 4-12)

	Cat 1-2 Zone	Cat 3-5 Zone	Non-Surge Zone
Safe	26	14	27
Not Safe	62	67	54
Do not Know	60	13	20

What people say they will do often fails to match what they actually do in real hurricane threats. Nevertheless, interviewees were asked a number of hypothetical questions. First, respondents were asked if they would do anything differently in the future if faced with another threat like Hurricane Georges. Most people said they would do the same thing they did in Hurricane Georges. Of those who did not evacuate from the category 1-2 zone in Hurricane Georges, however, 38 percent said they would leave in the future, as did 29 percent of the stayers in the category 3-5 zone and 19 percent in the non-surge area (Table 4-16). Fewer of the evacuees in each area said they would stay in the future.

TABLE 4-16
RESPONDENTS SAYING THEIR RESPONSE
IN HURRICANE GEORGES WOULD DIFFER IN THE FUTURE

	Cat 1-2 Zone	Cat 3-5 Zone	Non-Surge Zone
Stayers Who Would Leave	38	29	19
Leavers Who Would Stay	11	5	7

Those who did not evacuate in Hurricane Georges were asked where they would have gone if they did evacuate in a hurricane like Hurricane Georges. Four percent from the category 1-2 zone, 15 percent from the category 3-5 zone, and 10 percent from the non-surge zone insisted that they would not have left at all (no table).

All respondents were asked whether they would evacuate in a category 5 hurricane like Hurricane Camille. The great majority in all three risk areas said they would leave (Table 4-17). When asked where they would go if they did evacuate in a category 5 storm like Hurricane Camille, three percent from the category 1-2 area, nine percent from the category 3-5 zone, and seven percent from non-surge areas insisted that they would not leave at all.

TABLE 4-17
INTENDED RESPONSE IN CATEGORY 5 HURRICANE LIKE HURRICANE CAMILLE

	Cat 1-2 Zone (N=98)	Cat 3-5 Zone (N=94)	Non-Surge Zone (N=106)
Evacuate	87	78	84
Stay	8	18	13
Do not Know	5	4	3

Several variables were tested to see if they were associated with whether respondents evacuated in Hurricane Georges:

1. Mobile home residents were much more likely to leave than other respondents were (81 percent versus 39 percent overall).
2. People between the ages of 40 and 65 were less likely to evacuate than people both younger and older.
3. People who had lived in the region 30 years or more were less likely than others to evacuate.
4. People living alone were more likely than others to evacuate.
5. Renters were more likely than homeowners to leave.
6. Wealthier respondents were slightly less likely than others to evacuate.
7. Women were more likely than men to go.
8. These variables were not related to evacuation in Hurricane Georges:
 - a. Number of years lived in one's present home.
 - b. Presence of children in the home
 - c. Pet ownership
 - d. Race
 - e. Education

RESPONSE RECOMMENDATIONS

There is considerable perceived safety in the surge zones of the study area, and in Hurricane Georges relatively few respondents believed that evacuation notices applied to them. Even in the 1999 survey, which was targeted specifically at areas included in official evacuation notices, 60 percent of the interviewees said they did not hear evacuation notices from officials. Variation in response among the three risk areas was smaller than one should expect. Hurricane Georges had sustained winds of 105 mph during most of its threat to Mississippi, so the threat was not especially severe, although it was within the realm of forecast uncertainty for the storm to become have become a category 3 before landfall. The high incidence of non-evacuees saying they were concerned about being caught on roads is troubling and puzzling.

On the encouraging side, those who said they did hear evacuation notices were much more likely than others to evacuate in Hurricane Georges, especially if they thought the notices were mandatory. Also, the great majority of stayers said they had made preparations for leaving in case the threat had worsened. Mobile home residents were much more likely than others to have evacuated.

For an area ravaged by Hurricane Camille in 1969, evacuation response appears to be more of a problem in Mississippi than it should be. If officials are more aggressive about issuing evacuation notices and communicating them to the relevant population, response should be better than that which was observed in Hurricane Georges. The rates in Table 4-18 are recommended for planning, assuming that evacuation notices are issued and communicated successfully.

TABLE 4-18 EVACUATION PARTICIPATION RATES FOR PLANNING

Category 3 Storm			Category 1 Storm		
<i>Evacuation Ordered in Beach and Mainland Surge Areas And in Mobile Homes</i>			<i>Evacuation Ordered in Beach and Category 1 Surge Areas Only but in All Mobile Homes</i>		
Risk Area			Risk Area		
Cat 1/2 Surge Zone	Cat 3/5 Surge Zones	Non-Surge Zones	Cat 1/2 Surge Zone	Cat 3/5 Surge Zones	Non-Surge Zones
Housing Other Than Mobile Homes					
85%	70%	20%	70%	40%	10%
Mobile Homes					
95%	90%	70%	90%	70%	50%

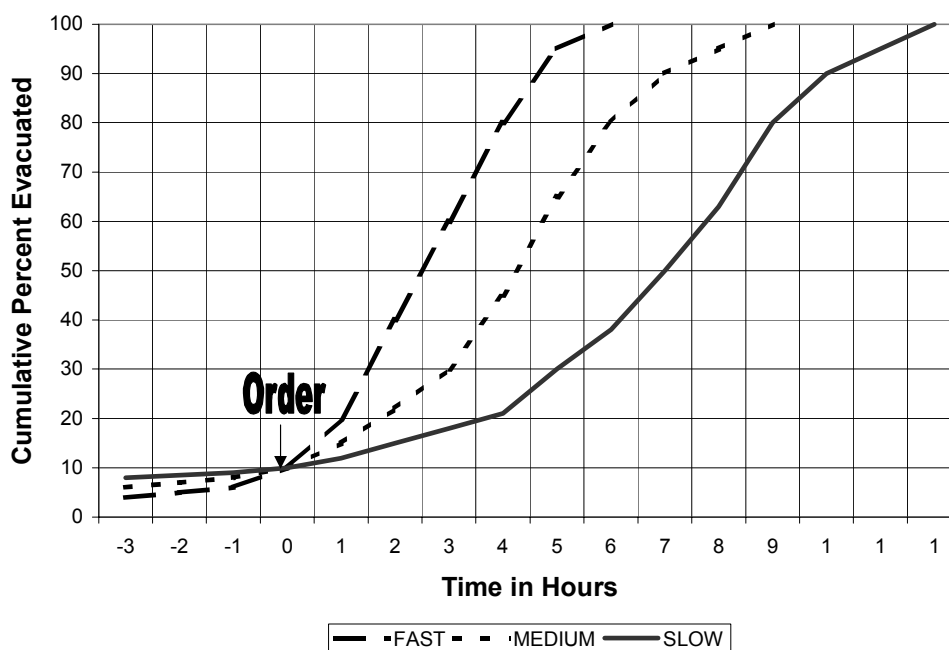
EVACUATION TIMING

Empirical evidence in evacuation after evacuation demonstrates emphatically that the very same people will leave promptly or gradually, depending upon the circumstances of the particular threat. When people believe they have the luxury of taking their time to depart, most tend to do so, even to the point of waiting until the following day to leave rather than travel at night. However, when the urgency of immediate response is successfully communicated to people, they respond very swiftly, even leaving between midnight and daybreak. That was demonstrated in Hurricane Eloise in Panama City, Florida in 1975 and in Hurricane Elena in the Tampa Bay area in 1985. In Hurricane Opal officials in some Panhandle counties called for evacuation the evening before the storm made landfall, but the evacuation did not commence in earnest until the following morning because residents did not perceive the urgency of leaving earlier. One other factor is also clear: very few evacuees (less than 20 percent) leave before officials issue an evacuation notice. Therefore, people are not going to leave in substantial numbers until someone in a position of authority tells them to and then they will leave as promptly as they are told they must. The urgency of evacuations varies because of the error inherent in hurricane forecasting. If a storm intensifies, increases forward speed, or changes course unexpectedly, it usually becomes more necessary for evacuees to leave quickly, as in Hurricanes Eloise and Opal.

The most recent survey in Mississippi did not ask Hurricane Georges evacuees the time of day and date they departed because of the length of time which had passed since the evacuation. However, the earlier post-Hurricane Georges survey in Mississippi did ask that question, and responses conformed to the generalizations stated above. Few evacuees left prior to the first evacuation notices being issued by public officials on Friday afternoon, and then proceeded gradually during the available time frame (18 percent on Friday, 49 percent on Saturday, and 26 percent on Sunday).

For planning, the three different timing response curves shown in Figure 4-1 should be evaluated, because eventually the region will experience all three. In each threat scenario occupants of inland areas will tend to wait longer to evacuate than those living in surge-prone locations. The actual number of hours over which the evacuation will occur can vary from place to place, depending upon the number of hours before anticipated landfall officials believe the evacuation must begin in order to allow time for completion.

Figure 4-1 Evacuation Response Curves



The curves in Figure 4-1 do not include a response being spread over a period of more than 24 hours such as, that which occurred in Hurricane Georges. If officials issue evacuation notices more than a full day prior to landfall the evacuation will be distributed over the entire time frame. When this occurs roughly 75 percent of the evacuation takes place in the first 12 daylight hours after the notice, and the remaining 25 percent take place in the following daylight hours.

TYPE OF REFUGE

Most evacuees go to the homes of friends and relatives when they evacuate, and that was clearly the case in Hurricane Georges in Mississippi (Table 4-19). There appears to have been a downward trend in reliance on public shelters during hurricane evacuations, starting at least with Hurricane Hugo in 1989. In Hurricane Georges only four percent of the evacuees from the category 1-2 and non-surge areas went to public shelters, although 16 percent went to public shelters in the



category 3-5 zone. However, all the samples were small and statistically unreliable when the sample is divided into three separate risk areas. The earlier post-Hurricane Georges survey in Mississippi had a larger number of evacuees (N=120), all from the area actually told in Hurricane Georges to evacuate, and only three percent of the evacuees went to public shelters.

TABLE 4-19
PERCENT OF EVACUEES IN HURRICANE GEORGES
GOING TO DIFFERENT TYPES OF REFUGE, BY RISK ZONE

	Cat 1-2 Zone (N=47)	Cat 3-5 Zone (N=38)	Non-Surge Zone (N=42)
Public Shelter	4	16	5
Friend/Relative	62	66	79
Hotel/Motel	23	8	7
Other	11	11	10

Those who did not evacuate in Hurricane Georges were asked where they would have gone if they had evacuated (Table 4-20). It is common for respondents to overstate their likelihood of going to public shelters, compared to actual subsequent behavior, and that is probably the case in the present survey also. The larger number of people saying they would go to hotels and motels might reflect naiveté about the availability of vacancies at such accommodations.

TABLE 4-20
REFUGES STAYERS IN HURRICANE GEORGES
SAID THEY WOULD HAVE USED IF THEY HAD
EVACUATED, BY RISK ZONE (PERCENT OF STAYERS)

	Cat 1-2 Zone (N=50)	Cat 3-5 Zone (N=43)	Non-Surge Zone (N=57)
Public Shelter	10	11	14
Friend/Relative	42	60	49
Hotel/Motel	36	16	16
Other	8	7	16
Do not Know	4	14	5

Interviewees were also asked what sort of refuge they would seek if they evacuated in a category 5 hurricane such as Hurricane Camille (Table 4-21). There was an increase in the number saying they would go to public shelters, possibly reflecting the belief that the homes of friends and relatives would not be safe enough in a storm like Hurricane Camille.

TABLE 4-21
INTENDED REFUGE FOR RESPONDENTS SAYING THEY
WOULD EVACUATE IN A CATEGORY 5 HURRICANE LIKE
HURRICANE CAMILLE BY RISK ZONE (PERCENT OF INTENDED EVACUEES)

	Cat 1-2 Zone (N=96)	Cat 3-5 Zone (N=86)	Non-Surge Zone (N=98)
Public Shelter	15	17	16
Friend/Relative	49	51	47
Hotel/Motel	25	11	20
Other/Do not Know	11	20	16

REFUGE TYPE RECOMMENDATIONS

There appears to have been a trend nationwide for fewer evacuees to rely on public shelters over the past decade or more. Certainly the shelter use in Hurricane Georges was substantially lower than in Hurricane Camille, for example. The planning recommendations in Table 4-22 are broken down into nine sets of circumstances, so that planners can tailor assumptions to shelters based on the nature of evacuees being served by the shelter. In general, evacuees from high-risk areas and wealthier evacuees tend to rely less than others on public shelters.

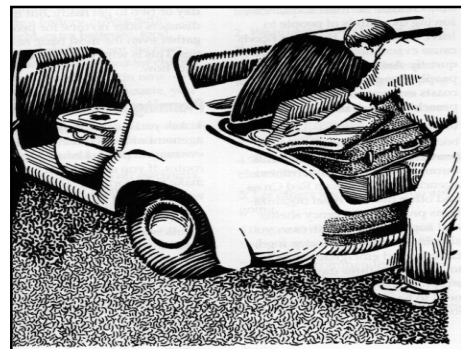
TABLE 4-22
PLANNING ASSUMPTIONS FOR PERCENT OF
EVACUEES SEEKING REFUGE IN PUBLIC SHELTERS

Income	<i>Risk Area</i>		
	<i>Cat 1-2 Surge Zone</i>	<i>Cat 3-5 Surge Zone</i>	<i>Non-Surge Zone</i>
High	5	5	5
Moderate	5	10	10
Low	10	20	20

EVACUATION DESTINATIONS

a. Refuge Locations

In Hurricane Georges approximately half the evacuees said they left their own county, with the percentage increasing slightly from the category 1-2 zone to the non-surge zone (Table 4-23). However, all the figures are based on samples with fewer than 50 respondents evacuating.



Taken collectively (averaging across the three risk areas), it is safe to say that more than half the evacuees left their own county. The earlier post-Hurricane Georges survey in Mississippi indicated 55 percent of the evacuees going out of county from the areas ordered to evacuate. At least a third of the evacuees went no farther than their own neighborhood.

TABLE 4-23
LOCATION OF REFUGES USED BY EVACUEES IN
HURRICANE GEORGES, BY RISK ZONE (PERCENT OF EVACUEES)

	Cat 1-2 Zone (N=46)	Cat 3-5 Zone (N=38)	Non-Surge Zone (N=42)
Own Neighborhood	33	42	33
Other Own County	24	3	7
Out of County	43	55	60

Of those who went out of county, most (70 percent to 76 percent) went to destinations in Mississippi (Table 4-24). Louisiana and Alabama were the next most popular destinations.

TABLE 4-24
LOCATION OF OUT-OF-COUNTY REFUGES
USED BY EVACUEES IN HURRICANE GEORGES
BY RISK ZONE (PERCENT OF OUT-OF-COUNTY EVACUEES)

	Cat 1-2 Zone (N=20)	Cat 3-5 Zone (N=21)	Non-Surge Zone (N=25)
Mississippi	70	71	76
Louisiana	15	14	4
Alabama	10	14	8
Other	1	0	12

Of those who didn't evacuate in Hurricane Georges, at least 60 percent said they would have gone out of county if they had evacuated (Table 4-25). Most of the rest said they would have gone someplace in their own neighborhood. Of those saying they would have gone out of county, most said they would have gone to places in Mississippi (Table 4-26).

TABLE 4-25
LOCATION OF REFUGES TO BE USED BY STAYERS
IN HURRICANE GEORGES WHO SAID THEY WOULD EVACUATE
IN THE FUTURE, BY RISK ZONE (PERCENT OF INTENDED EVACUEES)

	Cat 1-2 Zone (N=49)	Cat 3-5 Zone (N=47)	Non-Surge Zone (N=57)
Own Neighborhood	29	21	26
Other Own County	2	2	5
Out of County	65	68	60
Do not Know	4	9	7

TABLE 4-26
LOCATION OF OUT-OF-COUNTY REFUGES TO BE BY STAYERS
IN GEORGES WHO SAID THEY WOULD EVACUATE IN THE FUTURE
BY RISK ZONE (PERCENT OF INTENDED OUT-OF-COUNTY EVACUEES)

	Cat 1-2 Zone (N=34)	Cat 3-5 Zone (N=36)	Non-Surge Zone (N=38)
Mississippi	59	67	68
Louisiana	3	3	3
Alabama	21	0	3
Georgia	3	3	3
Florida	3	3	3
Texas	3	6	0
Arkansas/Tennessee	6	6	0
Other	0	8	8
Do not Know	3	6	13

When interviewees were asked where they would go if they evacuated for a category 5 hurricane like Hurricane Camille, most said they would go out of county, but there was more uncertainty expressed (Table 4-27). Among those saying they would go out of county, slightly fewer than in Hurricane Georges said they would go to Mississippi destinations, and about 15 percent said they did not know where they would go (Table 4-28).

TABLE 4-27
LOCATION OF REFUGES TO USED BY
INTENDED EVACUEES IN CATEGORY 5 HURRICANE
BY RISK ZONE (PERCENT OF INTENDED EVACUEES)

	Cat 1-2 Zone (N=94)	Cat 3-5 Zone (N=84)	Non-Surge Zone (N=98)
Own Neighborhood	22	21	29
Other Own County	10	4	7
Out of County	56	65	54
Do not Know	12	10	10

TABLE 4-28
LOCATION OF OUT-OF-COUNTY REFUGES TO BE USED
BY INTENDED EVACUEES IN CATEGORY 5 HURRICANE BY
RISK ZONE (PERCENT OF INTENDED OUT-OF-COUNTY EVACUEES)

	Cat 1-2 Zone (N=65)	Cat 3-5 Zone (N=63)	Non-Surge Zone (N=63)
Mississippi	46	54	56
Louisiana	8	10	3
Alabama	8	5	6
Georgia	6	3	2
Florida	3	2	2
Texas	5	5	0
Arkansas/Tennessee	6	5	6
Other	5	5	4
Don't Know	14	13	21

In Hurricane Georges 16 percent of the evacuees from Orleans and Jefferson Parishes in Louisiana said they went to destinations in Mississippi (Table 4-29), which was consistent with the 14 percent giving that response in the earlier post-Hurricane Georges survey in Louisiana. However, three percent said they went to places in Alabama, and nine percent went to Arkansas and Tennessee destinations, most of whom would have passed through Mississippi. The earlier post-Hurricane Georges survey found one percent of the New Orleans area evacuees going to Florida and two percent to Georgia, which would also have

affected Mississippi. It appears that at least 25 percent of the New Orleans area evacuees in Hurricane Georges either went to destinations in Mississippi or passed through Mississippi.

When respondents in New Orleans who didn't evacuate in Hurricane Georges were asked where they would have gone if they had evacuated, the pattern was similar in terms of its impact on Mississippi (Table 4-29). It was also comparable when New Orleans respondents were asked where they would go in a category 5 hurricane (Table 4-29).

**TABLE 4-29
NEW ORLEANS VICINITY EVACUEES IMPACTING MISSISSIPPI**

	Hurricane Georges Evacuees (N=104)	Hurricane Georges Stayers Hypothetical (N=77)	Category 5 Hypothetical (N=163)
Mississippi	16	10	17
Alabama	3	4	2
Georgia		4	2
Florida			1
Arkansas/Tennessee	9	8	7

People in Louisiana who went out of parish were asked why they went where they did, and those saying they would go out of parish in the future were asked why they would do so. The overwhelming majority either said they went to their chosen destinations because that's where they had friends or relatives and/or that's where they felt safe (Table 4-30). Many of those in Hurricane Georges also said the "evacuation route" went to those places.

**TABLE 4-30
REASONS GIVEN BY NEW ORLEANS RESPONDENTS
FOR CHOICE OF OUT-OF-COUNTY DESTINATIONS (PERCENT)**

	Hurricane Georges Evacuees (N=104)	Hurricane Georges Stayers Hypothetical (N=71)	Category 5 Hypothetical (N=167)
Friend/Relative	60	53	53
Safe	31	42	40
Evacuation Route	18	2	1

DESTINATION RECOMMENDATIONS

Although the differences in percent of evacuees going to destinations outside their own counties varied little among the three risk zones in Hurricane Georges, it is common for there to be variation in most hurricane evacuations. This is partly because evacuees from the more dangerous locations tend to leave earlier and therefore go farther. Therefore in Table 4-31 slightly higher out-of-county evacuation destinations are recommended for planning in the more hazardous areas. Stronger storms will result in more of the evacuees leaving the local area.

**TABLE 4-31
PLANNING ASSUMPTIONS FOR PERCENT
OF EVACUEES LEAVING THEIR OWN COUNTY**

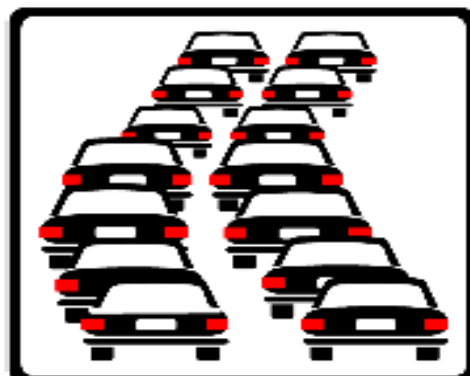
	Category 3 Storm	Category 1 Storm
Cat 1-2 Surge Zone	65	50
Cat 3-5 Surge Zone	60	45
Non-Surge Zone	55	40

Planners should assume that 25 percent to 30 percent of evacuees from the New Orleans vicinity would pass into or through Mississippi, with more coming from Jefferson Parish than Orleans. Anticipating the percentage of New Orleans residents that will actually evacuate is more complicated however.

Approximately half the respondents from the New Orleans area left their homes to go someplace safer in Hurricane Georges, and that was notably more than in Hurricanes Andrew in 1992 and Elena in 1985. It was also in the absence of mandatory evacuation orders. It appears reasonable to expect that in some severe threat scenarios 75 percent of the New Orleans vicinity population could evacuate.

VEHICLE USAGE

Transportation modeling requires knowledge of the number of vehicles evacuating, more than the number of people. Also some vehicles such as trailers and motor homes impact traffic flow more than other vehicles. Finally emergency management officials need to anticipate the number of people who will need their assistance in order to evacuate.



Not all vehicles available to households are actually taken in evacuations. The normal range is 65 percent to 75 percent, and that was the case in Hurricane Georges in Mississippi (Table 4-32). The actual number of vehicles per household varied from 1.15 in the category 1-2 zone to 1.49 in the category 3-5 zone. An average of five percent of the evacuating households took motor-homes or pulled trailers or campers.

**TABLE 4-32
VEHICLE USE IN HURRICANE GEORGES**

	Cat 1-2 Zone (N=47)	Cat 3-5 Zone (N=39)	Non-Surge Zone (N=42)
Percent of Available Vehicles	68%	74%	65%
Vehicles per Household	1.15	1.49	1.29
Trailer, Camper, Motor home	7%	3%	5%

No one who failed to evacuate in Hurricane Georges said it was due to a lack of available transportation. When asked directly, however, eight percent of the non-evacuating households included someone who would have required assistance in order to evacuate. More than half of those involved someone with a special care need, rather than just needing transportation. A third of those needing assistance said they would require help from an outside agency, rather than from within the household or from a friend or relative.

Among evacuating households in Hurricane Georges, four percent said someone in the household required assistance in order to evacuate, about half having a special care need. In 20 percent of those households the assistance was provided by an outside agency.

VEHICLE USE RECOMMENDATIONS

Planners should assume that 70 percent of the available vehicles will be used in evacuations, and that five percent of the evacuating households will pull a trailer or take a motorhome or camper.

VISITOR SURVEY

Face to face interviews were conducted with visitors to Mississippi in July of 2000. They were asked questions about hazard perception, response intentions in hypothetical hurricane threats, and personal characteristics, which might affect

their response. The interviews were conducted at welcome centers (on I-10 east and west of the coast), on casino properties, and at the beach as shown in Table 4-33.

**TABLE 4-33
LOCATION OF INTERVIEWS (NUMBER)**

Welcome centers	85
Casinos	67
Beach	47
Mall	1

Respondents were asked the main purpose or purposes of their trip to the Mississippi Coast. Most mentioned some aspect of the casinos, but most also said they were there for a combination of reasons (Table 4-34). Respondents could state more than one primary purpose for the trip.

**TABLE 4-34
PURPOSE OF VISIT (PERCENT)**

Casino gambling	20
Casino entertainment	4
Casino, general	37
Beach	25
Other recreation	7
Business	11
Convention	4
Friend/relatives	15
Combination	54

Most visitors said their entire stay would consist of three or fewer days (Table 4-35), and about half had just one day remaining of their stay at the time they were interviewed. This is potentially significant in a hurricane threat. It is likely that a visitor's stay would be near its end if a hurricane threat arose during the visit, and that could mitigate the visitor's reluctance to evacuate, particularly if evacuation meant returning home.

**TABLE 4-35
DURATION OF STAY IN DAYS (PERCENT)**

	Total Visit	Days Remaining
1	13	48
2	26	20
3	24	14
4	16	11
5	8	3
6	3	4
7 or more	11	1

The great majority of respondents drove to the Mississippi coast, 85 percent in a car (Table 4-36). Five percent were in a motorhome, and two percent pulled a trailer or camper. This indicates that the great majority of visitors have their own vehicle in which to evacuate (rather than being stranded at the airport, for example).

**TABLE 4-36
MODE OF TRANSPORTATION TO MISSISSIPPI COAST**

Drove car	85
Drove motorhome	5
Pulled trailer	1
Pulled camper	1
Flew, scheduled commercial carrier	5
Flew, charter	1
Flew, private aircraft	1
Tour bus	2

Most respondents were in a small party (Table 4-37). It consisted almost entirely of friends and relatives (Table 4-38).

**TABLE 4-37
NUMBER OF PEOPLE IN PARTY (PERCENT OF PARTIES)**

1	8
2	47
3	16
4	12
5	5
6	6
More than 6	7

**TABLE 4-38
OTHERS IN GROUP (PERCENT OF PARTIES)**

Alone	9
Friends	16
Family	69
Friends and family	7

Most visitors (81percent) said they planned to return home after their stay in Mississippi, but 17 percent said they planned to go elsewhere (Table 4-39).

**TABLE 4-39
PLANS AT END OF VISIT TO MISSISSIPPI COAST (PERCENT)**

Return home	81
Go elsewhere	17
Do not know	2

Six states account for the homes of 85 percent of the visitors interviewed. Louisiana and Florida had the largest number of visitors (Table 4-40), but the distribution varied depending upon where the interviews were conducted. Florida visitors were less likely than others to go be at the beach, for example, and the I-10 welcome centers included no visitors from Mississippi.

TABLE 4-40 PERCENT OF VISITORS BY HOME STATE

	Interview Location		
	Beach	Casino	Welcome Center
Alabama	11	15	8
Arkansas	5	0	0
Florida	4	19	15
Georgia	4	6	7
Louisiana	26	21	28
Mississippi	19	19	0
Tennessee	6	2	1
Texas	11	3	16
Other	14	15	25

Most respondents were staying at casino hotels, and another 26 percent were at other hotels and motels (Table 4-41). A third of the accommodations were on the beach or bay, and more than half were either on or less than a block from the water (Table 4-42). At least half, and probably more, of the visitors interviewed were staying in places having more than 3 stories (Table 4-43).

**TABLE 4-41
TYPE OF ACCOMMODATIONS (PERCENT)**

Casino hotel	56
Other hotel/motel	26
Condominium	4
Beach house	1
Campground	5
Friend/relative	6
Other	4

**TABLE 4-42
LOCATION OF ACCOMMODATIONS (PERCENT)**

Beach/Bayfront	34
< 1 block from waterfront	26
1 block from waterfront	5
> 1 block from waterfront	17

**TABLE 4-43
NUMBER OF FLOOR (STORIES) OF ACCOMMODATIONS (PERCENT)**

1	14
2	15
3	4
More than 3	49
Do not know	19

Most people said they did not have to make any sort of advance payment for their accommodations, and most of the remainder said it was just a deposit for the first night's stay or to secure a reservation (Table 4-44). There should be little concern about advance payments deterring visitors from evacuating. Table 4-45 shows the nightly room cost of by percent of those interviewed.

TABLE 4-44
MADE ADVANCE PAYMENT FOR ACCOMMODATIONS (PERCENT)

None	67
First night deposit/reservation guarantee	20
Full amount	10
Do not know	3

TABLE 4-45
COST OF ACCOMMODATIONS PER NIGHT (PERCENT)

Free	20
< \$50	17
\$50 to \$100	32
> \$100	7
Declined to answer	2
Do not know	24

Eighteen percent said this was their first visit to the Mississippi coast, and another six percent said it was their second (Table 4-46). Half the sample said they had visited at least five times before. This suggests a high level of familiarity by most visitors with the area and probably with evacuation route options.

TABLE 4-46
NUMBER OF PREVIOUS VISITS TO MISSISSIPPI COAST (PERCENT)

0	18
1	6
2	10
3	8
4	3
5	7
More than 5	50

A third of the sample was under the age of 40, and 21 percent were over 60 (Table 4-47). Half the respondents were male and half female (Table 4-48).

TABLE 4-47
AGE OF RESPONDENT (PERCENT)

< 21	3
21 to 40	29
41 to 60	44
Over 60	21
Declined to answer	3

TABLE 4-48
GENDER OF RESPONDENT (PERCENT)

Male	49
Female	51

HAZARD PERCEPTION

Perceived safety of one's residence is a strong predictor of evacuation behavior among residents. Visitors were asked whether the places they were staying while on the Mississippi coast would be safe in a 90 mph category 1 hurricane. Almost half (40 percent) said their accommodations would be safe (Table 4-49). Respondents were then asked whether their lodging would be safe in a more powerful category 3 hurricane with winds of 125 mph. Only 12 percent said their accommodations would be safe (Table 4-50). The implication is that in a weak hurricane many visitors would be unlikely to leave if their decision were made strictly on the basis of perceived safety. In a strong storm few would be inclined to stay, even without mandatory evacuation orders. There were no associations between perceived safety and visitor characteristics discussed earlier. Even proximity of one's lodging to water was not correlated with perceived safety.

TABLE 4-49
BELIEF ACCOMMODATIONS WOULD BE
SAFE IN 90 MPH HURRICANE (PERCENT)

Safe	40
Unsafe	52
Depends on storm	1
Do not know	9

**TABLE 4-50
BELIEF ACCOMMODATIONS WOULD BE
SAFE IN 125 MPH HURRICANE (PERCENT)**

Safe	12
Unsafe	79
Depends on storm	2
Do not know	8

INTENDED RESPONSE

Interviewees were asked whether they had considered what they would do if a hurricane threatened the area while they were visiting. Most said they had, but a third said they had not (Table 4-51). This would not necessarily prevent visitors from evacuating, but might inhibit a prompt, definite response.

**TABLE 4-51
CONTEMPLATED RESPONSE TO HURRICANE THREAT (PERCENT)**

Yes	65
A little	4
No	32

Three hypothetical hurricane threats were posed to visitors, and they were asked how they would respond in each. The first scenario was a category 1 hurricane with winds of 90 mph. A hurricane watch was in effect from New Orleans to Pensacola, local officials and casino and hotel management had not said anything about whether guests should evacuate, and the weather was still good. Respondents could give more than one answer to the question.

Twenty-eight percent said they would leave at that time and go home (Table 4-52). A total of 47 percent said they would leave and either go home, to another vacation area, or inland. Most said they would stay put and wait for more information. Residents are known to overstate their likelihood of evacuating early in a scenario such as this. There is no comparative data for visitors, but visitors have less reason to stay than residents, especially given the relatively short duration of their planned stays.

TABLE 4-52
INTENDED RESPONSE IN 90 MPH HURRICANE
WATCH, NO EVACUATION ORDER, GOOD WEATHER (PERCENT)

Leave for other vacation area	2
Leave for home	28
Leave for nearby destination inland	6
Go north/inland	11
Check with management for advice	7
Wait for more information	31
Stay put	31
Do not know	8
Depends on storm	2

Perceived safety of one's accommodations was a good predictor of intended response in the scenario. People who said their lodging would be unsafe in either a category 1 or 3 hurricane were more likely than others to say they would leave in the hypothetical threat scenario.

Interviewees were next asked what they would do in a much stronger hurricane, a category 3 storm with winds of 125 mph. Again, there was a hurricane watch, no evacuation notices, and good weather. In this instance 45 percent said they would head for home, and a total of 72 percent would leave to go someplace else (Table 4-53). Note, however, that respondents were permitted to give more than one response, so there is some double counting. A fifth of those saying they would go north or inland, for example, also said they would go home.

TABLE 4-53
INTENDED RESPONSE IN 125 MPH HURRICANE, WATCH,
NO EVACUATION ORDER, GOOD WEATHER (PERCENT)

Leave for other vacation area	5
Leave for home	45
Leave for nearby destination inland	6
Go north/inland	16
Check with management for advice	7
Wait for more information	19
Stay put	14
Do not know	7
Depends on storm	4

People who said they had considered what they would do in a hurricane threat were more likely than others to say they would leave in this threat scenario, as were those who said their accommodations would be unsafe in category 1 and 3 hurricanes. Visitors who said they had been to the area 3 or more times were also more likely than others to say they would leave in this scenario.

The final scenario posed a category 3 hurricane with winds of 125 mph, but with a hurricane warning in effect and mandatory evacuation orders including hotels and motels. Casinos were being closed for business, the storm was closer, and the weather was starting to become windy and rainy. Most respondents (61 percent) said they would leave for home, and 98% said they would leave to go someplace (Table 4-54). Again, however, there was some double counting among the “leave” categories. Only eight percent said they would wait for more information and/or check with management for advice. Clearly almost everyone anticipated leaving, but not necessarily for home.

TABLE 4-54
INTENDED RESPONSE IN 125 MPH HURRICANE, WARNING, EVACUATION ORDER, CASINOS CLOSED, STORM CLOSER, WEATHER BAD (PERCENT)

Leave for other vacation area	5
Leave for home	61
Leave for nearby destination inland	10
Go north/inland	22
Check with management for advice	4
Wait for more information	4
Find safer place	3
Go where told	7
Depends on storm	3

When asked specifically where they would go when they evacuated for a 125 mph hurricane, 55 percent said they would go home (Table 4-55). However, excluding the “do not know” and “would not leave” responses, 63 percent of those saying they would leave and who knew where they would go said they would go home. Eight percent said they would go to public shelters, which could create difficulties for shelter providers. Residents are known to exaggerate their likelihood of using public shelters, but it isn’t known whether this is true of visitors. Twelve percent would seek hotels and motels, but demand could exceed supply.

**TABLE 4-55
INTENDED DESTINATION EVACUATION
FOR 125 MPH HURRICANE (PERCENT)**

Home	55
Public shelter	8
Hotel/motel	12
Friend/relative	9
Other	6
Do not know	11
Wouldn't evacuate	2

Visitors were asked specific geographical destinations to which they would go, and those responses were provided to transportation analysts working on the hurricane evacuation study. Respondents were also asked the routes they would use in reaching their destinations. The most striking figure is that 40 percent said they did not know which routes they would use. (Note: Excluding the "do not know" responses from calculations almost doubles the percentages in Table 4-56.) The "do not know" responses could have been prompted by a lack of thought about how to respond to such a threat, or it could indicate recognition that route decisions would need to wait until road congestion could be assessed.

**TABLE 4-56
INTENDED ROADS TO USE IN
EVACUATION FOR 125 MPH HURRICANE (PERCENT)**

I-10 East	19
I-10 West	24
I-49 North	15
I-59 North	5
I-55 North	5
I-65 North	12
I-12 West	4
US 90 West	2
Do not know	40

RESPONSE IN PAST HURRICANE THREATS

Visitors were asked if they had ever been on the Mississippi Coast in the past when a hurricane threatened, and 14 percent said they had, but no more than three percent mentioned any single storm (Hurricane Georges). Taken all together (and some threats would have been greater than others, some virtually non-existent), 26 percent said they evacuated home. Half said they did not evacuate, and four percent said they went to a local public shelter.

OVERALL PLANNING RECOMMENDATIONS

Participation Rate. There is little to suggest that visitors to the Mississippi coast will be reluctant to evacuate in a hurricane threat if officials order evacuation. There is little motive for visitors to remain and little cost to their leaving. In most scenarios visitor evacuation will probably be higher than that by residents. In strong storms with official evacuation orders, at least 90 percent of the visitors will leave their accommodations to go someplace safer. In weak storms it is especially important for officials to issue evacuation orders if they want visitors to leave from category 1-2 surge areas. Without such notices, most visitors will stay or attempt to leave late during the threat.

Timing. Visitors will leave at least as early as residents, and few will leave before evacuation notices are issued. The same timing curves used for residents should be used for visitors.

Refuges. When asked where they would go when they evacuated in a category 3 hurricane eight percent of the respondents said they would go to a public shelter. Residents typically overstate their likelihood of going to public shelters, but it is not known whether this is also true of visitors. Most would leave for home, but many would not. A third of the respondents said they hadn't given much thought to what they would do in a hurricane threat, 18 percent were visiting for the first time, at least 15 percent live in states far enough away to make returning home an attractive option, and 40 percent do not know what route they would take in evacuating. Many of the 12 percent who intend to go to hotels and motels might be unable to find vacant accommodations. The greatest potential demand for public shelters will come from visitors who wait too long to leave. Officials can minimize that number by ordering evacuation early and communicating the message aggressively. It would be prudent to plan for 10 percent of the evacuating visitors to seek refuge in public shelters unless officials take explicit action to discourage that response, although the most probable figure is five percent.

Destinations. In a threat from a strong hurricane most evacuating visitors will return home, and 90 percent of the evacuees will go to destinations outside the three coastal Mississippi counties.

Transportation. Almost all the visitors to the Mississippi coast have their own transportation available to them (90 percent). Others have chartered buses or planes. Five percent of the respondents said they flew into the area on scheduled commercial flights. Many of those have the potential to be stranded, although some have rented vehicles. Five percent have motorhomes or trailers.